further statutory powers no accurate account of the quantity and value can be given. Thanks to the courtesy of the owners, who have furnished returns voluntarily, accurate statistics of the output of the shallow ironstone quarries of the Midlands have been secured; and in like manner the output of salt from brineworks has been calculated. The exports and imports of each of the principal minerals, furnished by the Board of Customs, are given after the tables of production, and in several cases information as to distribution, supplied by railway and navigation companies, is added. Lists of smelters of the principal metallic ores follow the export and import tables, and in the case of iron the quantity of ore and coal used in the blast furnaces, and the make of pig iron, have been ascertained from voluntary returns furnished to the Home Office by the owners. The volume includes a table of the mines inspection districts, with the names and addresses of the inspectors of mines, assistant inspectors, secretaries to boards for examinations, and the Clerk of Mineral Statistics. The return also supplies a general summary of the value of minerals obtained from the colonies. The figures for 1895 were: Africa and Mediterranean, £5,506,739; Asia, £5,874,144; Australasia, £13,919,068; Europe, £139,289; North America, £3,842,586; South America, £446,695; and British West India Islands, £101,550; total, £29,830,071, as compared with £28,765,009 in 1894.

UNIVERSITY AND EDUCATIONAL NEWS.

Professor James M. Crafts has been elected President of the Massachusetts Institute of Technology. Professor Crafts holds the chair of organic chemistry in the Institute and has been the acting president since the death of General Walker.

At Cambridge University Mr. J. B. Peace, M.A., Fellow of Emmanuel College, has been appointed demonstrator in mechanism and applied mechanics for five years, and Mr. H. Higgins, M.A., of King's College, has been reappointed demonstrator of anatomy for five years.

Dr. Mollier, of Göttingen, has been appointed professor of mechanical engineering in the Technological Institute at Dresden

The New York City Board of Superintendents hold an examination for principalships of grammar schools on November 3d, 5th and 8th, which are open to candidates from any part of the United States having an experience of ten years in teaching. The salaries are from $2,500 to $3,500 per annum.

DISCUSSION AND CORRESPONDENCE.

LEWIS ON THE DIAMOND.

In two papers* recently published Mr. George F. Kunz has reviewed 'Papers and notes on the genesis and matrix of the diamond by the late Henry Carvill Lewis.' In each he attributes to Lewis the theory that South African diamonds have resulted from the intrusion of igneous rocks into and through carbonaceous shales, and the crystallization of the carbon throughout the rock as it cooled, from hydrocarbons distilled from the shale that had been broken through. In his communication to Science, however, Mr. Kunz admits that in these papers Lewis does not distinctly assert that the shales are the origin of the carbon. Mr. Kunz derives his authority for his representations on this point from conversations with Lewis ten years or more ago.

It seems to me that Mr. Kunz does Lewis a serious injustice. Had the latter wished to commit himself in print to this theory it would have been easy for him to express himself in terms as positive as those which Mr. Kunz employs. Far from doing so he appears to support a radically different theory, viz., that the diamonds are phenocrysts and an integral part of the lava. In the following paragraphs I shall quote every phrase in these two papers which bears on the subject, the rest of the text consisting of lithological discussions and the like.

In his first paper, page 6, Lewis properly attributed the hypothesis of the derivation of the carbon from the shales to Mr. E. J. Dunn.† Lewis expresses no assent to this hypothesis, at least in this connection, and merely comments:

* Production of Precious Stones in the United States, U. S. Geol. Survey, Mineral Resources, 1896; and this Journal, Sept. 17, 1897.

† Quar. Jour. Geol. Soc., Vol. 37, 1881, p. 610.

"If so, the atmosphere would be the original source of the diamond." A little later he remarks:

"The earlier theories as to the origin of the diamond have, in the light of new facts, quite given way to the theory that the diamonds belong to and are a part of the matrix in which they lie, and that this matrix is in some way of volcanic origin, either in the form of mud or ashes or lava." On page 8, however, he says:

"The rock occurs in two types, one not bearing diamonds, the other diamantiferous, and the distinction between them is suggestive. Both occur in the same mine, and are dark, compact, heavy rocks, closely resembling one another, and differing mainly in the fact that one is free from enclosures of foreign substance, while the other is full of fragments of shale and other impurities. It is the latter which is diamantiferous." What is suggested by the difference between these rocks Lewis does not further indicate. He was mistaken as to the facts, as he afterwards appears to have learned.

In his second paper, read in 1887, Lewis, in describing the mode of occurrence of the diamonds, remarks:

"It is interesting also to find that they become more abundant the deeper they are from the surface, and where also the volcanic action was more intense. * * * * * Carbonados and black diamonds are also common, not only in large crystals, but very abundantly as minute, almost microscopic, crystals. The abundance of these minute crystals is another proof that they are not enclosures brought up from some other matrix." He sums up the evidence as to the origin of the diamonds as follows:

"The explorations of the last few years have placed it beyond question that the serpentine rock, called 'blue ground,' is in reality the matrix of the diamond. For a time it was thought that the diamonds were washed into 'kopjes' from above, being mere alluvial deposits, as held by Mr. Cooper and others; afterwards, and until the present time, the idea has been general that they were carried up from below along with other inclusions, and that their true matrix was some gneiss or itacolumite, far below, from which they had become detached by volcanic agency. Others again, such as Döll, hold that, while the serpentinous rock is the matrix of the diamond, the latter is a secondary mineral due to the decomposition of the rock. But recent investigations seem to place it beyond question that diamonds are as much a part of the Kimberley rock as biotite, garnet, titanic and chromic iron and perovskite, and that, like these minerals, they may be considered as a rock ingredient. The fact that they continue just as abundant, if not more so, the deeper the mines are explored: that they are never found in, or especially associated with, the foreign inclusions of gneiss, granite or sandstone: that they are distributed abundantly through all parts of the rock: and that in each of the four principal mines the diamonds have distinctive features of color, lustre and shape, are, with the microscopical evidence of the eruptive character of the rock, strong reasons for holding that the diamonds now lie in their original matrix." This passage will bear but one interpretation and seems to represent Lewis's final opinion.

Later he refers to the fact discovered by Sir Henry Roscoe that the 'blue ground' contains a soluble hydrocarbon, but confines himself to characterizing this as a most interesting chemical observation. Lewis also presents Chaper's results, according to which the rock of the Kimberley mines results from a series of eruptions, between each of which there was time for the volcanic mass to consolidate, and in some of the mines it is possible to make out a chronology of the various eruptions.

The only other passages pertinent in this connection are those referring to the occurrence of fractured diamonds. The fact that fragments of crystals are often found in the mine he explains as due to the bursting of the diamonds on exposure to the atmosphere. He also notes, however, that many of the other porphyritic crystals of the kimberlite are broken.

Whatever Lewis may have said in conversation, his deliberately recorded opinion is that the diamond is a rock ingredient, as much a part of the rock as the garnet or the biotite. It cannot have been his wish to be represented as holding an opinion which, in these papers at least, he nowhere expressed, and from which he withheld his assent.

Lewis never visited Kimberley. I have done so, and from field observations reached the same conclusion as he did from the study of collections. Unfortunately my collection disappeared in transit, but a few notes may tend to throw a little additional light on the subject of the genesis of the diamond.

The De Beers mine and the Kimberley mine are each extensively developed, the former to 1,200 feet and the latter to 1,600 feet. As is well known, the mines are in volcanic necks. I gathered some evidence that these necks are not drilled through the rocks, but are local enlargements of persistent fissures. The adjacent rocks are in a nearly horizontal position and include quartzites, shales, sheets of melaphyre and of basalt. The quartzites are also cut by dikes of basic eruptives. The only bituminous rock in the district is the black shale, which is about 180 feet thick at the De Beers and 250 feet at the Kimberley. At each mine the under surface of this shale is only at the very moderate depth of about 350 feet from grass. In the upper part of the mines the kimberlite carried very numerous fragments of the shale. Below the shale stratum, however, the shale horses or 'floating reef' diminished in number very greatly, so that at over a thousand feet of depth only occasional fragments of shale are to be found. Those which I saw seemed totally unaltered. The edges of the fragments were sharp and there was no macroscopical evidence of any loss of carbon. Much of the lava is brecciated, but much also is solid with gradations between the two varieties. There is one well marked dike in the De Beers. It is known as the Snake, from its meandering course. It was determined by Stelzner as pikrite porphyry and as substantially the same rock as the blue ground itself. The 'Snake,' however, contains no diamonds.

The diamonds are distributed throughout the necks, excepting that they never occur either in horses (whether of shale or of other rock) or in the snake dike. They are found in what appears to be massive lava as well as in the breccia, but there are portions of the mass which are too poor in diamonds to pay for extraction. The diamonds are not grouped about, or especially associated with, extraneous fragments. On the other hand, they are curiously grouped in vertical pipes within the necks. The existence of these pipes was pointed out by Mr. M. Chaper and they were discussed by Mr. A. Moule. The diamonds from the several pipes seem to differ not only in abundance, but also in tint or physical character, so that with care a discrimination is possible. The pipes apparently represent successive eruptions.

It is important to note that the contents of blue ground in diamonds remains very nearly constant at different levels. The De Beers mine is now some 850 feet below the bottom of the shale, the Kimberley about 1,250 feet, and the walls of the necks or of the deposits contain no sensible amount of carbon over these intervals of depth, yet the average number of carats per 'load' of 16 cubic feet (about 1,600 pounds) does not vary to an important extent. The yield per load for the year ending June 30, 1896 (viz., 0.91), was almost exactly the same as for the year ending June 30, 1892 (viz., 0.92). In 1893 it was somewhat higher, in 1894 and 1895 somewhat lower. Now, to imagine that the carbon has come from the shale and permeated the lava downwards, in opposition to the flow of melted rock, to such depths as 1,000 feet, without great diminution of quantity, is almost impossible. One can, indeed, fancy still more deeply seated shale beds, but for this hypothesis there is no evidence at all.

While the diamond appears to be an original constituent of the kimberlite and occurs in South Africa in this manner at many localities, it may be classed as accessory, rather than an essential mineral, if there is any real distinction between these groups. Some of the rock is rich, some too poor to be worked, and some seems to be absolutely barren in diamonds. So also there are basaltic rocks poor in olivine and passing over into varieties substantially barren so far as this mineral is concerned. Similarly granites are sometimes rich in zircon and sometimes poor. Even so-called essential constituents, such as the quartz of granite, likewise vary in quantity, as, for example, when a granite passes over a syenite.

Lewis seems to have confounded two phenomena in discussing fractured diamonds. There are diamonds usually of a brownish tint which, after being exposed to the air for some

time, disintegrate. There are also diamonds of all colors and qualities which are found in the mines in a broken state. These are not cases of fracture in mining, whether by the use of explosives or otherwise. The fragments are embedded in the matrix and the crytals have been broken before final consolidation of the lava took place. They seem precisely analogous to the broken phenocrysts of hornblende or feldspar not infrequently found in lavas and such as Lewis found in kimberlite; it is asserted that in a solitary case two complementary portions of a single diamond have been found, one of them coming from a depth of two hundred feet greater than the other.*

Mr. Kunz inclines to ascribe the fracturing of diamonds to the brecciation of the lava. If this were the correct explanation one would expect to find the diamond fragments only at the surfaces of rock fragments, and to hear of complementary portions of diamond crystals found near together. The few specimens of still embedded fragments which I had an opportunity of inspecting did not bear out the theory of brecciation fracture, and I have noted above the only instance I could learn of in which complementary fragments have been discovered. It seems to me more probable that the diamonds and other fractured phenocrysts in massive lavas have been broken at the moment of explosive ejection from the volcanic melting-hearth.

I am not in a position to discuss Sir Henry Roscoe's discovery of a soluble hydrocarbon in the blue, for I do not know whether the massive lava free from shale, in the deeper workings, does or does not contain it. If it does, the origin of this substance would probably be most easily explained as similar to that of the crystallized carbon, and as due to some such process as that to which Mr. Mendeleeff ascribes the formation of the Baku petroleum, the decomposition of carboniferous, terrestrial, metallic iron.

In closing this criticism it is appropriate to quote the opinion of Mr. Gardner F. Williams,† a mining engineer who for many years has managed the De Beers consolidated mines with conspicuous ability. "The proofs are most conclusive that the diamonds were not formed *in situ*, but have come up from below with the blue ground."

GEORGE F. BECKER.

WASHINGTON, D. C., October, 1897.

*E. J. Loomis, Eclipse party in South Africa, 1896, p. 121.

† Second annual report of the De Beers consolidated mines for the year ending March 31, 1890. In this report Mr. Williams quotes Stelzner as having determined the 'snake dike' as pikrite porphyry and the blue ground as essentially the same rock. The melaphyre sheet underlying the bituminous shale Stelzner considered as olivine diabase. Mr. Williams probably took these determinations from letters, for I can find no publication by Stelzner on the subject until 1893 (Isis Society, Dresden). In this paper Stelzner adopted Lewis' term 'kimberlite' for the blue ground. He assented to Knop's view, that the kimberlite magma was itself carboniferous or hydrocarboniferous and that the diamond crystallized out as a primitive rock constituent. He mentioned, as of special bearing on this subject, a specimen presented by Mr. Williams to the Freiberg Museum, a fragment of diamond which is intergrown with pyrope and is thus presumably from the same habitat as this essential element of the kimberlite.

NOTE ON 'THE EASTERNMOST VOLCANOES OF THE UNITED STATES.'

IN a letter published in SCIENCE (Vol. VI., No. 146, pp. 594–595, October 15, 1897) Mr. Robert T. Hill tries to correct the map showing the distribution of volcanoes in the United States, plate 5, published in 'Professor I. C. Russell's magnificent volume on the *Volcanoes of North America.*' He says the "conclusions on the part of Professor Russell are erroneous and mar his otherwise excellent work, for some of the most beautiful and perfect volcanic craters in the United States occur in New Mexico." Consequently Mr. Hill gives a sketch of the New Mexican region, giving 'supplementary data concerning the distribution of volcanic phenomena.' Among the omissions of the true craters of New Mexico, which have escaped Mr. Russell's notice, the groups of volcanic cones and craters with flows of lava, called the Cerrito, lying between Galisteo and the Rio Grande are quoted in the letter, but erroneously marked in the accompanying sketch as forming a line of three black discs or craters at the western